Name _____ Date _____ Class _____

Cell Membranes and Permeability

Pre-Lab Discussion

Can all substances move in both directions through a cell membrane? Why do some substances enter the cell through the cell membrane, while others do not? Sometimes you can use a model to answer questions like these. Part of this investigation models a living cell, so that you can observe changes that the cell membrane controls.

The cell membrane determines what diffuses into a cell. This characteristic of a cell membrane is called permeability. Many cells are semipermeable, which means that not all substances can pass through the cell membrane. Also, the amount of a substance that diffuses through a membrane is influenced by concentration and time.

In this investigation, you will model a cell membrane, determine if the membrane is permeable to certain substances, and find out if the concentration of a substance affects its diffusion.

1. Where is the cell membrane of a cell?

_____

_____

2. What types of materials pass through the cell membrane?

_____

_____

Problem

How does a cell membrane work?

Materials *(per group)*

plastic lunch bag
twist tie
100-mL graduated cylinder
starch solution
200-mL beaker
glass-marking pencil
water
iodine solution, three strengths
3 test tubes
test-tube rack
3 plastic cups
potato cubes
clock or watch with second hand
forceps
metric ruler

Cell Membranes and Permeability *(continued)*

Safety *Review the safety guidelines in Appendix A.*

Iodine is poisonous. Keep it away from your face, and wash your hands thoroughly after using it. Iodine will stain your hands and clothing, so be careful not to spill it. Handle glass objects carefully. If they break, tell the teacher. Do not pick up broken glass.

Procedure

Part A: Model of a Cell Membrane

1. Write your name on a beaker with a glass-marking pencil. Then label three test tubes as follows: (1) "Iodine BEFORE," (2) "Iodine AFTER," and (3) "Starch."

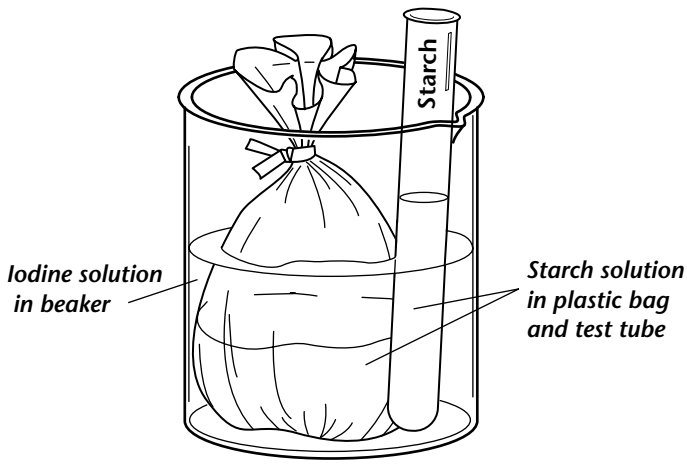

Figure 1

2. Fill the beaker with 40 mL of iodine solution. **CAUTION:** *Be careful with the iodine solution. If you spill any on yourself, immediately rinse the area with water and tell your teacher.* The iodine solution represents the environment outside the model cell.

3. Fill the test tube labeled "Iodine BEFORE" one-fourth full with iodine solution, and then set it aside in a test tube rack.

4. Fill a plastic lunch bag with 40 mL of starch solution, and seal the bag with a twist tie. Be careful not to spill starch onto the outside of the bag. Record the color of the solution in Data Table 1, and then place the bag into the solution in the beaker. The bag represents a cell.

5. Fill the "Starch" test tube about one-half full with starch solution, record the color of the solution, and then place the test tube in the beaker as shown in Figure 1. Let the beaker and its contents stand overnight.

6. The next day, remove the plastic bag and the test tube from the beaker. Record the colors of the solutions in the plastic bag and the test tube in the "Color AFTER" column in Data Table 1.

7. Pour iodine solution from the beaker into the test tube labeled "Iodine AFTER" until the test tube has the same amount of solution as the test tube labeled "Iodine BEFORE."
8. Hold the two test tubes side by side, and look down through their openings. Record the colors of the solutions in the last line of Data Table 1.

Part B: Effect of Concentration on Diffusion

1. Label three plastic cups *100%*, *50%*, and *10%*.
2. Obtain about 30 mL of iodine solution at each strength, and pour that amount into the appropriate cup. Record these concentrations in Data Table 2.
3. Put a potato cube in each beaker. If necessary, add additional solution to cover the cube completely. Record the exact time the cubes were added to the solutions in Data Table 2.

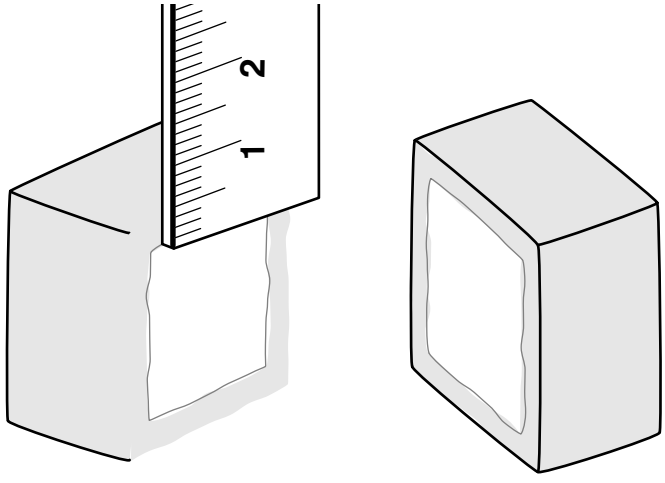

Figure 2

4. After 30 minutes, use forceps to remove each potato cube from its solution. Keep track of which sample was in which beaker. The teacher will cut your potato cubes in half.
5. Use a metric ruler to determine the distance that the solution has diffused into each potato cube. See Figure 2. Read each distance to the closest 0.5 mm. In Data Table 2, record the distance that the solution diffused into each cube.

Cell Membranes and Permeability *(continued)*

Observations

Data Table 1

Solution	Color Before	Color After
Starch in model cell		
Starch in test tube		
Iodine in test tubes		

Data Table 2

Potato Cube	Concentration of Substance	Distance of Diffusion (mm)
1		
2		
3		

Analyze and Conclude

1. What part of the cell does the plastic bag represent?

_____

_____

2. What was the purpose of placing a test tube containing starch solution in the beaker of iodine?

_____

_____

3. When starch mixes with iodine, the mixture turns blue. What can you infer about the contents of the plastic bag?

_____

_____

4. a. Did starch move out of the bag? Give a reason for your answer.

_____

_____

b. Did iodine move into the bag? Give a reason for your answer.

_____

_____

5. Based on your results, was the model cell membrane permeable or impermeable to iodine? To starch?

_____

_____

6. In Part B, how did the concentration of iodine influence the amount of diffusion that took place?

_____

_____

Critical Thinking and Applications

1. Cell membranes contain small holes, or pores. Pore size may determine why some chemicals can or cannot pass through a cell membrane. In your model, how might the size of the membrane pores compare to the size of the iodine molecules? Explain.

_____

_____

_____

2. In your model, how might the size of the membrane pores compare to the size of the starch molecules? Explain.

_____

_____

_____

3. Based on what you learned from studying the diffusion of different concentrations, what might be one reason that sick or injured people wear oxygen masks? Explain.

_____

_____

_____

Cell Membranes and Permeability *(continued)*

More to Explore

New Problem How does time affect the diffusion of substances across a cell membrane?

Possible Materials Consider which materials you can use from the previous part of the lab.

Safety Handle glass objects carefully. Ask your teacher to cut the potato cubes.

Procedure Develop a procedure to solve the problem. Predict what the results will show. Write your procedure on a separate sheet of paper. Have the teacher approve your procedure before you carry out the investigation.

Observations On a separate sheet of paper, make a data table in which to record your data and observations.

Analyze and Conclude Did your results support your prediction? Explain your reasoning.

_____

_____

_____

_____